CLAIMS

1. An ink jet printhead comprising:

a plurality of nozzles; and

at least one respective heater element corresponding to each nozzle, wherein

each heater element is covered by a conformal protective coating, the coating of each heater element having been applied to all sides of the heater element simultaneously such that the coating is seamless;

each heater element is arranged for being in thermal contact with a bubble forming liquid, and

each heater element is configured to heat at least part of the bubble forming liquid to a temperature above its boiling point to form a gas bubble therein thereby to cause the ejection of a drop of the bubble forming liquid through the nozzle corresponding to that heater element.

2. The printhead of claim 1 being configured to support the bubble forming liquid in thermal contact with each said heater element.

3. The printhead of claim 1 being configured to print on a page and to be a page-width printhead.

4. The printhead of claim 1 wherein the coating of each heater element is substantially electrically non-conductive.

5. The printhead of claim 1 wherein the coating of each heater element is substantially chemically inert.

6. The printhead of claim 1 wherein the coating of each heater element has a high thermal conductivity.

7. The printhead of claim 1 wherein the coating of each heater element is aluminium nitride.

8. The printhead of claim 1 wherein the coating of each heater element is diamond-like carbon (DLC).

9. The printhead of claim 1 wherein the coating of each heater element is boron nitride.

10. The printhead of claim 1 wherein each heater element is in the form of a suspended beam, that is suspended over at least a portion of the bubble forming liquid so as to be in thermal contact therewith.

11. The printhead of claim 1 wherein each heater element is configured such that an actuation energy of less than 500 nanojoules (nJ) is required to be applied to that heater element to heat that heater element sufficiently to form said bubble in the bubble forming liquid thereby to cause the ejection of said drop.

12. The printhead of claim 1 configured to receive a supply of the bubble forming liquid at an ambient temperature, wherein each heater element is configured such that the energy required to be applied thereto to heat said part to cause the ejection of said drop is less than the energy required to heat a volume of said bubble forming liquid equal to the volume of the said drop, from a temperature equal to said ambient temperature to said boiling point.

13. The printhead of claim 1 comprising a substrate having a substrate surface, wherein each nozzle has a nozzle aperture opening through the substrate surface, and wherein the areal density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square cm of substrate surface.

14. The printhead of claim 1 wherein each heater element has a pair of planar surfaces on opposite sides of the element, that element being suspended such that each of the planar surfaces is in thermal contact with the bubble forming liquid such that the bubble is formed at both of the element surfaces.

15. The printhead of claim 1 wherein the bubble which each heater element is configured to form is collapsible and has a point of collapse, and wherein each heater

element is configured such that the point of collapse of a bubble formed thereby is spaced from that heater element.

16. The printhead of claim 1 comprising a structure that is formed by chemical vapor deposition (CVD), said nozzles being incorporated in the structure.

17. The printhead of claim 1 comprising a structure which is less than 10 microns thick, said nozzles being incorporated in the structure.

18. The printhead of claim 1 comprising a plurality of nozzle chambers, each corresponding to a respective nozzle, and a plurality of said heater elements being disposed within each chamber, the heater elements within each chamber being formedin different respective layers to one another.

19. The printhead of claim 1 wherein each heater element is formed of solid material more than 90% of which, by atomic proportion, is constituted by at least one periodic element having an atomic number below 50.

20. The printhead of claim 1 wherein each heater element includes solid material and has a mass of less than 10 nanograms of the solid material of that heater element to be heated to a temperature above said boiling point thereby to heat said part of the bubble forming liquid to a temperature above said boiling point to cause the ejection of said drop.

21. A printer system incorporating a printhead, the printhead comprising:
a plurality of nozzles; and

at least one respective heater element corresponding to each nozzle, wherein

each heater element is covered by a conformal protective coating, the coating of each heater element having been applied to all sides of the heater element simultaneously such that the coating is seamless;

each heater element is arranged for being in thermal contact with a bubble forming liquid, and

each heater element is configured to heat at least part of the bubble forming liquid to a temperature above its boiling point to form a gas bubble therein thereby to cause the

ejection of a drop of the bubble forming liquid through the nozzle corresponding to that heater element.

22. The system of claim 21 being configured to support the bubble forming liquid in thermal contact with each said heater element.

23. The system of claim 21 being configured to print on a page and to be a page-width printhead.

24. The system of claim 21 wherein the coating of each heater element is substantially electrically non-conductive.

25. The system of claim 21 wherein the coating of each heater element is substantially chemically inert.

26. The system of claim 21 wherein the coating of each heater element has a high thermal conductivity.

27. The system of claim 21 wherein the coating of each heater element is aluminum nitride.

28. The system of claim 21 wherein the coating of each heater element is diamond-like carbon (DLC).

29. The system of claim 21 wherein the coating of each heater element is boron nitride.

30. The system of claim 21 wherein each heater element is in the form of a suspended beam, that is suspended over at least a portion of the bubble forming liquid so as to be in thermal contact therewith.

31. The system of claim 21 wherein each heater element is configured such that an actuation energy of less than 500 nanojoules (nJ) is required to be applied to that heater

element to heat that heater element sufficiently to form said bubble in the bubble forming liquid thereby to cause the ejection of said drop.

32. The system of claim 21, wherein the printhead is configured to receive a supply of the bubble forming liquid at an ambient temperature, and wherein each heater element is configured such that the energy required to be applied thereto to heat said part to cause the ejection of said drop is less than the energy required to heat a volume of said bubble forming liquid equal to the volume of the said drop, from a temperature equal to said ambient temperature to said boiling point.

33. The system of claim 21 comprising a substrate having a substrate surface, wherein each nozzle has a nozzle aperture opening through the substrate surface, and wherein the areal density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square cm of substrate surface.

34. The system of claim 21 wherein each heater element has a pair of planar surfaces on opposite sides of the element, that element being suspended such that each of the planar surfaces is in thermal contact with the bubble forming liquid such that the bubble is formed at both of the element surfaces.

35. The system of claim 21 wherein the bubble which each heater element is configured to form is collapsible and has a point of collapse, and wherein each heater element is configured such that the point of collapse of a bubble formed thereby is spaced from that heater element.

36. The system of claim 21 comprising a structure that is formed by chemical vapor deposition (CVD), said nozzles being incorporated in the structure.

37. The system of claim 21 comprising a structure which is less than 10 microns thick, said nozzles being incorporated in the structure.

38. The system of claim 21 comprising a plurality of nozzle chambers, each corresponding to a respective nozzle, and a plurality of said heater elements being disposed

within each chamber, the heater elements within each chamber being formed in different respective layers to one another.

39. The system of claim 21 wherein each heater element is formed of solid material more than 90% of which, by atomic proportion, is constituted by at least one periodic element having an atomic number below 50.

40. The system of claim 21 wherein each heater element includes solid material and has a mass of less than 10 nanograms of the solid material of that heater element to be heated to a temperature above said boiling point thereby to heat said part of the bubble forming liquid to a temperature above said boiling point to cause the ejection of said drop.

41. A method of ejecting a drop of a bubble forming liquid from a printhead, the printhead comprising a plurality of nozzles and at least one respective heater element corresponding to each nozzle, the method comprising the steps of:

providing the printhead, including applying to each heater element, to all sides thereof simultaneously, a conformal protective coating such that the coating is seamless;

heating at least one heater element corresponding to a said nozzle so as to heat at least part of a bubble forming liquid which is in thermal contact with the at least one heated heater element to a temperature above the boiling point of the bubble forming liquid;

generating a gas bubble in the bubble forming liquid by said step of heating; and

causing the drop of bubble forming liquid to be ejected through the nozzle corresponding to the at least one heated heater element by said step of generating a gas bubble.

42. The method of claim 41 comprising, before said step of heating, the steps of: disposing the bubble forming liquid in thermal contact with the heater elements.

43. The method of claim 41 wherein, in the step of providing the printhead, the applying of a conformal coating comprises applying a conformal coating which is substantially electrically non-conductive.

44. The method of claim 41 wherein, in the step of providing the printhead, the applying of a conformal coating comprises applying a conformal coating which is substantially chemically inert.

45. The method of claim 41 wherein, in the step of providing the printhead, the applying of a conformal coating comprises applying a conformal coating which has a high thermal conductivity.

46. The method of claim 41 wherein, in the step of providing the printhead, the applying of a conformal coating comprises applying a conformal coating which is aluminum nitride.

47. The method of claim 41 wherein, in the step of providing the printhead, the applying of a conformal coating comprises applying a conformal coating which is diamond-like carbon (DLC).

48. The method of claim 41 wherein, in the step of providing the printhead, the applying of a conformal coating comprises applying a conformal coating which is boron nitride.

49. The method of claim 41 wherein each heater element is in the form of a suspended beam, the method further comprising, prior to the step of heating at least one heater element, the step of disposing the bubble forming liquid such that the heater elements are positioned above, and in thermal contact with, at least a portion of the bubble forming liquid.

50. The method of claim 41 wherein the step of heating at least one heater element is effected by applying an actuation energy of less than 500nJ to each such heater element.

51. The method of claim 41, comprising, prior to the step of heating at least one heater element, the step of receiving a supply of the bubble forming liquid, at an ambient temperature, to the printhead, wherein the step of heating is effected by applying heat energy to each such heater element, wherein said applied heat energy is less than the energy required to heat a volume of said bubble forming liquid equal to the volume of said drop, from a temperature equal to said ambient temperature to said boiling point.

52. The method of claim 41 wherein, in the step of providing the printhead, the printhead includes a substrate on which said nozzles are disposed, the substrate having a substrate surface, and the areal density of the nozzles relative to the substrate surface exceeding 10,000 nozzles per square cm of substrate surface.

53. The method of claim 41 wherein each heater element has a pair of planar surfaces on opposite sides of the element, and wherein, in the step of generating a gas bubble, the bubble is generated at both of said planar surfaces of each heated heater element.

54. The method of claim 41 wherein, in the step of generating a gas bubble, the generated bubble is collapsible and has a point of collapse, and is generated such that the point of collapse is spaced from the at least one heated heater element.

55. The method of claim 41 wherein the step of providing the printhead includes forming a structure by chemical vapor deposition (CVD), the structure incorporating the nozzles therein

56. The method of claim 41 wherein, in the step of providing the printhead, the printhead includes a structure which is less than 10 microns thick and which incorporates said nozzles therein.

57. The method of claim 41 wherein the printhead has a plurality of nozzle chambers, each chamber corresponding to a respective nozzle and wherein the step of providing the printhead includes forming a plurality of said heater elements in each chamber, such that the heater elements in each chamber are formed in different respective layers to one another.

58. The method of claim 41 wherein, in the step of providing the printhead, each heater element is formed of solid material more than 90% of which, by atomic proportion, is constituted by at least one periodic element having an atomic number below 50.

59. The method of claim 41 wherein each heater element includes solid material and has a mass less than 10 nanograms and wherein the step of heating at least one element includes heating the solid material of each such heater element to a temperature above said boiling point.